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Development of a Northern Hemisphere Gridded Precipitation Dataset Spanning the Past Half Millennium for Analyzing Interannual and Longer Term Variability in the Monsoons

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Abstract: While much past proxy work has focused on the reconstruction of large-scale surface temperature patterns, there is perhaps no more societally relevant climate variable than precipitation. Yet, no comprehensive large-scale reconstructions of precipitation for the Northern Hemisphere (i.e., all of North America and Asia) have been performed spanning the past millennium. This proposed reconstruction project will use all available proxy-climatic records spanning the last 500-2000 years in the Northern Hemisphere to develop: 1) gridded seasonal and annual precipitation datasets for North America, Europe and Asia with various spatial resolutions and dataset lengths, and 2) a 2.5ÅãÅ~2.5Åã latitude and longitude annual (and/or summer) precipitation dataset of the last 500 years for the Northern Hemisphere. The proposed reconstruction activities will make use of two different Climate Field Reconstruction (CFR) techniques, in particular, the regularize expectation maximization algorithm (_RegEM‘), and the multivariate principal component (_PC‘) method, to establish results that are both skillful and robust with respect to the details of the statistical methodology.
The gridded precipitation datasets will be interpreted in the context of climate dynamical mechanisms responsible for interannual to centennial timescale variability in different regions and continents over the past 500-2000 years. Specific emphasis will be placed on understanding the potential roles of the Asian and North American monsoons, and climate modes such as the El Nino/Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO), and the Atlantic Multidecadal Oscillation (AMO), in past variations in precipitation and drought. Particular attention will also be paid to the relationships with past variations in temperature documented in recently published reconstruction efforts.
One key outcome of the proposed research is a better knowledge of the natural range of precipitation variation, and its relationship with larger-scale climate dynamics, for policymakers and stakeholders who need to gauge societal vulnerability to variations in water on timescales of decades to centuries, be it natural and anthropogenic in origin. The proposed project promises to improve the scope, both in space and time, of hydroclimatic reconstructions available for such purposes.